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72: Inventor: Tetsuji Yamazaki

Dai Nippon Printing Co., Ltd, 7 Enoki-cho, Shinjuku-ku, Tokyo, Japan

71: Applicant: Dai Nippon Printing Co., Ltd, 1-1-1 Ichigaya Kaga-cho 1-1-1, Shinjuku-ku, Tokyo, Japan

74: Agent: Patent Attorney: Hisao Kamata

Specification

1. Title of the invention

Hologram and Fabrication Method thereof

2. Claims

(1) A hologram having a light-scattering pattern formed on a part of a recording surface having a hologram image recorded

thereon.

(2) The hologram according to claim 1, wherein the light-scattering pattern is used as a register mark for position detection when processing a replicated hologram.

(3) A hologram fabrication method for forming a light-scattering pattern on a part of a recording surface having a hologram image formed thereon, comprising: overlapping a mask pattern that allows light to be partially transmitted therethrough and a light-scattering plate that scatters the transmitted light on a photoresist surface where the hologram image is exposed; applying the light from the light-scattering plate side to perform pattern exposure on the photoresist surface; and then developing the photoresist surface to form the light-scattering pattern.

(4) A hologram fabrication method for forming a light-scattering pattern on a part of a recording surface having a hologram image formed thereon, wherein a roughening treatment such as sandblasting or rough surface printing is performed with respect to a part of a photoresist surface having the hologram image formed thereon or a part of a surface of a replica fabricated based on the photoresist surface, thereby forming the light-scattering pattern.

3. Detailed Description of the Invention

[Field of the Invention]

The present invention relates to a hologram having a

light-scattering pattern different from the periphery formed on a hologram recording surface and to a fabrication method thereof.

[Prior Art]

Although various types of display holograms that can be reproduced with white light are suggested, there is a demand of adding a pattern image such as a character or a figure in addition to a hologram image as a main constituent in order to improve visibility or prevent forgery.

As this type of hologram fabrication method, for example, there has been conventionally suggested recording a different hologram having a specific pattern simultaneously or in a multiple manner when recording a hologram as a main constituent or printing an image having a specific pattern on a display body having a hologram recorded thereon by a known method.

[Problem to be Solved by the Invention]

According to a method for recording a hologram having a specific pattern like the former, since the specific pattern is a hologram and recognized like an image of the main hologram, there arises a problem that a visual difference between both the images is small and the specific pattern is indistinctive.

To solve this problem, although a difference from the main hologram can be highlighted by changing a pitch or an

angle of interference fringes of the hologram having the specific pattern, an image can be seen from a specific direction alone in case of the hologram, and a problem that the visible range is restricted cannot be solved.

According to the latter method for printing a specific pattern, when replicating holograms in large quantities by embossing and the like, replication and printing must be carried out in different processes, and hence there occurs a problem of an increase in production cost.

Further, positioning of a hologram image and a printed image, which is so-called registering, must be performed, and a special printer that can detect an image position of a hologram is required to increase an accuracy for the registering.

It is an object of the present invention to provide an easily viewable hologram having an image of a specific pattern added thereto separately from an image of a main hologram and a hologram fabrication method that enables easily fabricating such a hologram.

[Means for Solving Problem]

To solve the problem, in a hologram according to the present invention, a light-scattering pattern is formed on a part of a recording surface having a hologram image recorded thereon.

In this case, when processing a replicated hologram, the

light-scattering pattern is used as a register mark for position detection.

A hologram fabrication method according to the present invention, which is a hologram fabrication method for forming a light-scattering pattern formed on a part of a recording surface having a hologram image recorded thereon, comprises: overlapping a mask pattern that allows light to be partially transmitted therethrough and a light-scattering plate that scatters the transmitted light on a photoresist surface where the hologram image is exposed; applying the light from the light-scattering plate side to perform pattern exposure on the photoresist surface; and then developing the photoresist surface to form the light-scattering pattern.

Furthermore, in a hologram fabrication method according to the present invention, which is a hologram fabrication method for forming a light-scattering pattern formed on a part of a recording surface having a hologram image recorded thereon, a roughening treatment such as sandblasting or rough surface printing is performed with respect to a part of a photoresist surface having the hologram image formed thereon or a part of a surface of a replica fabricated based on the photoresist surface, thereby forming the light-scattering pattern.

[Embodiments]

The present invention will now be described hereinafter

based on embodiments with reference to drawings and others.

FIG. 1 is a perspective view schematically showing an embodiment of a hologram according to the present invention.

In a hologram 1, light-scattering patterns 12 and 13 having interference patterns partially exposed to random scattered light are formed on a part of a recording surface 10 where a hologram image 11 is recorded.

The light-scattering light 12 is a fine uneven pattern having a random size, and it is formed as an uneven pattern like a hologram image 11 provided at the periphery. Therefore, the hologram image 11 and the light-scattering patterns 12 and 13 can be replicated in large quantities by a method such as embossing.

Additionally, since the light-scattering patterns 12 and 13 are the uneven patterns as described above and light are randomly scattered, pattern regions of these patterns can be clearly visually recognized from all directions. That is, each light-scattering pattern can be seen like a pattern printed using a white ink and rarely has angle dependence of reproduction, and hence it can be easily seen from all directions.

The light-scattering pattern 13 can be used as a register mark for detecting a position of the hologram image 11 when processing a product of the hologram 1. The hologram image 11 usually requires specific optical conditions for

reproduction, and a special reproduction light source and a photodetector must be used to detect a position of the hologram image 11. When the light-scattering pattern 13 is used as the register mark like the present invention, the same detector as that for regular printed matters can be used. Therefore, this pattern can be used for position detection at processing steps, e.g., transfer, punching, printing, and others of a hologram product.

FIG. 2 to FIG. 8 are views showing a first embodiment of a hologram fabrication method according to the present invention, FIG. 2 is a view for explaining an entire process, FIG. 3 is a view for explaining a photoresist dry plate, FIG. 4 is a view for explaining an exposure process of a hologram, FIG. 5 is views for explaining a light-scattering pattern exposure process, FIG. 6 is a view for explaining a hologram original board, FIG. 7 is views for explaining a replica mold fabrication process, and FIG. 8 is views for explaining a replication process.

The hologram fabrication method according to the first embodiment is constituted of a hologram exposure process 21, a light-scattering patter exposure process 22, a development process 23, a replica mold fabrication process 24, and a replication process 25 as shown in FIG. 2.

The hologram exposure process 21 is a process for recording a hologram image on a photoresist dry plate having

a photoresist surface formed thereon.

In the hologram exposure process 21, a hologram image can be recorded by a method for, e.g., a Fresnel hologram, an image hologram, a rainbow hologram, or diffraction gratings.

As shown in FIG. 3, the photoresist dry plate 3 used here has a photoresist layer 32 formed on one side of a substrate 31, and there is an example of the photoresist dry plate 31 obtained by applying a photoresist (Microposit 1300 manufactured by Shipley Company L. L. C.) having a thickness of 1.5 μm to one side of a glass plate.

When recording, e.g., an image hologram on this photoresist dry plate 3, such a photographic optical system as shown in FIG. 4 can be used to perform photographing as follows.

That is, coherent illumination light 40 is applied to a subject 41, and an image is formed on the photoresist dry plate 3 by an imaging lens 42 to interfere with coherent reference light 44, thereby recording an actual image 41a of the subject as a hologram. In regard to each of the illumination light 40 and the reference light 44, an Ar* laser that emits coherent light having a wavelength of 457.9 nm can be used.

The light-scattering pattern exposure process 22 is a process for placing a mask pattern that allows light to be partially transmitted therethrough and a light-scattering

plate that scatters transmitted light on the photoresist surface and applying light from the light-scattering plate side to perform pattern exposure of the photoresist surface.

That is, as shown in FIG. 5A, the mask pattern 51 and the light-scattering plate 52 are placed to overlap the photoresist dry plate 3 exposed in such a manner that the actual image 41a of the subject can serve as a hologram image as depicted in FIG. 4, and this structure is exposed to light 53.

A mask pattern having transmitting portions 51a and 51b with specific patterns formed in a film made of a silver halide photosensitive material or the like can be used as the mask pattern 51 (FIG. 5B), and frosted glass or the like can be used as the light-scattering plate 52.

As the light 53 used for exposure, coherent light emitted from, e.g., an Ar* laser or an He-Cd laser is preferable. In case of using the coherent light for exposure, the same light source as that used in the hologram exposure process 21 can be adopted. When the photoresist dry plate 3, the mask pattern 51, and a light-scattering surface of the light-scattering plate 52 are appressed against each other, incoherent light from, e.g., an UV (ultraviolet) lamp can be used for exposure.

It is to be noted that the exposure in the hologram exposure process 21 and that in the light-scattering pattern

exposure process 22 may be carried out in the reverse order, or they may be carried out at the same time.

The development process 23 is a process for developing the photoresist dry plate 3 to obtain a hologram original board 6.

When the photoresist dry plate 3 exposed as shown in FIG. 5 is developed in the usual manner, the hologram original board 6 having a hologram image 61 and a light-scattering pattern 62 recorded thereon can be obtained.

The replica mold fabrication process 24 is a process for fabricating a replica mold 7 using the hologram original board 6 as shown in FIG. 7.

That is, the hologram original board 6 (shown in FIG. 6) is subjected to electrolytic plating using Ni or the like to form a plating film 71 (FIG. 7A), then this plating film 71 is delaminated, and this delamination can be utilized to fabricate a replica mold 72 (FIG. 7B).

As shown in FIG. 8, the replication process 25 is a process for fabricating a lot of hologram replicas 81 using the replica mold 72.

For example, when the replica mold 72 is used to emboss a vinyl chloride sheet, the same relief hologram replica 81 as the hologram original board 6 can be obtained.

Further, a recording surface of this replica 81 is vacuum-deposited to form a reflecting layer 82, an adhesive

83 is applied to a back side of the reflecting layer 82, a sheet of exfoliate paper 84 is attached to a back side of the adhesive 83, and then this structure is punched into a predetermined shape, thereby fabricating a hologram pressure-sensitive adhesive label 8.

Here, when performing the punching, a register mark 13 recorded as a part of the light-scattering pattern can be used for positioning of the punching.

In the obtained pressure-sensitive adhesive label 8, the hologram image 11 can be reproduced from a specific angle, and the light-scattering patterns 12 and 13 can be seen like patterns printed with a white ink and can be clearly visually recognized from all directions.

FIG. 9 is a view showing a modification of the first embodiment of a hologram fabrication method according to the present invention.

In this example, the hologram exposure process 21 and the light-scattering pattern exposure process 22 can be carried out at the same time.

That is, as shown in FIG. 9, the mask pattern 51 and the light-scattering plate 52 are arranged on the back side of the photoresist dry plate 3, the hologram is exposed to light by the optical system depicted in FIG. 4 from the front surface of the photoresist dry plate 3 and, at the same time, the light-scattering pattern is exposed to the light 53 from

the back side.

In this case, since the substrate 31 is present between the mask pattern 51 and the photoresist surface 32, it is preferable to perform the exposure using coherent light such as a laser beam as an exposure light source. In this case, the light used for hologram exposure can be led by a catoptric system and the like to be adopted for exposure of the light-scattering patterns.

FIG. 10 is a process chart showing a second embodiment of a hologram fabrication method according to the present invention, and FIG. 11 is views for explaining a sandblasting process in the method according to this embodiment.

As shown in FIG. 10, the hologram fabrication method according to the second embodiment is constituted of a hologram exposure process 101, a development process 102, a replica mold fabrication process 103, a sandblasting process 104, and a replication process 105.

When a hologram image is exposed on a photoresist dry plate using the optical system depicted in FIG. 4 (101) and then the photoresist dry plate is developed (102), a hologram original board is fabricated.

Like the process shown in FIG. 7, the hologram original board is subjected to electrolytic plating, thereby fabricating a replica mold 111 (103).

Subsequently, as shown in FIG. 11A, a protective sheet

112 having pattern-like opening portions 112a is placed to overlap the replica mold 111, and sandblasting for blasting granular matters 113 is carried out, whereby a surface of the replica mold 111 is roughened into the pattern of the opening portions 112a (104).

The replica mold 114 having the light-scattering pattern 114b formed on a part of the hologram recording surface 114a is used to press a relief pattern of the hologram image and the light-scattering pattern with respect to a material such as plastic like an example shown in FIG. 8, thereby performing replication based on embossing (105).

It is to be noted that the replica mold 114 can be further subjected to electrolytic plating to fabricate the plurality of same replica molds. Additionally, although the sandblasting has been performed with respect to the replica mold, the photoresist dry play may be directly subjected to the sandblasting if it has sufficient strength.

FIG. 12 is a process chart showing a third embodiment of a hologram fabrication method according to the present invention, and FIG. 13 is views for explaining a rough surface printing process in the method according to this embodiment.

The hologram fabrication method according to the third embodiment is constituted of a hologram exposure process 121, a development process 122, a rough surface printing process

123, a replica mold fabrication process 124, and a replication process 125 as shown in FIG. 12.

A hologram original board 141 is fabricated like the second embodiment (121, 122).

As shown in FIG. 13A, a silk screen 132 having pattern-like transmitting portions 132a is placed to overlap a surface of the hologram original board 131, and a rough surface serving as a light-scattering pattern is partially formed on the surface of the hologram original board 131 by, e.g., a screen printing method for applying a roughening ink 133 using a stage 134.

As the roughening ink 133, a material having a large amount of pigment contained in an ink can be used.

The surface of this hologram original board 13 is subjected to electrolytic plating to fabricate a replica mold (124), thereby replicating a hologram (125).

It is to be noted that the replica mold can be further subjected to electrolytic plating to fabricate the plurality of same replica molds. Further, after fabricating the replica mold once, this replica mold can be subjected to rough surface printing to again fabricate the replica mold.

[Effect of the Invention]

As described above in detail, according to claim (1), since a light-scattering pattern different from a hologram image at the periphery is recorded, an image can be prevented

from being completely invisible depending on a viewing angle. Furthermore, since the light-scattering pattern is provided by recording an uneven pattern like the hologram image, the replication process can be carried out in the same process.

According to claim (2), since the light-scattering pattern can be detected by a regular detector, positional detection can be easily carried out.

According to claims (3) and (4), the above-described hologram can be very easily fabricated.

In particular, when the light-scattering pattern is optically fabricated like claim (3), a possibility that a workpiece is damaged can be reduced, and the photoresist original board can be directly processed, thereby providing a simple fabrication process. Furthermore, the optical processing enables processing a very fine pattern.

4. Brief Description of Drawings

FIG. 1 is a perspective view schematically showing an embodiment of a hologram according to the present invention.

FIG. 2 to FIG. 8 are views showing a first embodiment of a hologram fabrication method according to the present invention, where FIG. 2 is a view for explaining an entire process, FIG. 3 is a view for explaining a photoresist dry plate, FIG. 4 is a view for explaining an exposure process of a hologram, FIG. 5 is views for explaining a light-scattering pattern exposure process, FIG. 6 is a view for explaining a

hologram original board, FIG. 7 is views for explaining a replica mold fabrication process, and FIG. 8 is views for explaining a replication process.

FIG. 9 is a view showing a modification of the first embodiment of the hologram fabrication method according to the present invention.

FIG. 10 is a process chart showing a second embodiment of a hologram fabrication method according to the present invention, and FIG. 11 is views for explaining a sandblasting process in the method according to the second embodiment.

FIG. 12 is a process chart showing a third embodiment of a hologram fabrication method according to the present invention, and FIG. 13 is views for explaining a rough surface printing process in the method according to this embodiment.

1 ... hologram

10 ... recording surface

11 ... hologram image

12 ... light-scattering pattern

13 ... register mark

21 ... hologram exposure process

22 ... light-scattering pattern exposure process

23 ... development process

24 ... replica mold fabrication process

25 ... replication process

3 ... photoresist dry plate

31 ... substrate

32 ... photoresist layer

4 ... hologram photographing optical system

40 ... illumination light

41 ... subject

42 ... imaging lens

43 ... object light

44 ... reference light

41a ... actual image of subject

51 ... mask pattern

52 ... light-scattering plate

6 ... hologram original board

62 ... light-scattering pattern

7 ... replica mold

8 ... hologram pressure-sensitive adhesive label

81 ... replica

82 ... reflecting surface

83 ... adhesive

84 ... exfoliate paper

Agent/Patent Attorney: Hisao Kamata

[FIG. 2]

21: HOLOGRAM EXPOSURE

22: LIGHT-SCATTERING PATTERN EXPOSURE

23: DEVELOPMENT

24: REPLICA MOLD FABRICATION

25: REPLICATION

[FIG. 4]

3: PHOTORESIST DRY PLATE

41a: ACTUAL IMAGE OF SUBJECT

44: REFERENCE LIGHT

43: OBJECT LIGHT

42: IMAGING LENS

40: ILLUMINATION LIGHT

41: SUBJECT

[FIG. 5A]

EXPOSURE

[FIG. 10]

101: HOLOGRAM EXPOSURE

102: DEVELOPMENT

103: REPLICA MOLD FABRICATION

104: SANDBLASTING

105: REPLICATION

[FIG. 12]

121: HOLOGRAM EXPOSURE

122: DEVELOPMENT

123: ROUGH SURFACE PRINTING

124: REPLICA MOLD FABRICATION

125: REPLICATION